

Application. No. 10/730,162

Paper dated June 8, 2007

Reply to Final Office Action of February 8, 2007

and Advisory Action of April 26, 2007

Attorney Docket No. 4444-032065

### **REMARKS**

On April 26, 2007, the Examiner issued an Advisory Action directed to a Response After Final Rejection, dated April 9, 2007. In this Response, the Examiner indicated that he still considers the prior art of record to teach all of the limitations as claimed, and that one of ordinary skill in the art would be motivated to combine the Ward patent and the '099 publication. The Examiner's comments have been carefully considered. The present Amendment modifies claims 1, 14, 15, 17 and 20 in accordance with the originally-filed specification, and cancels claim 3. Support for these amendments can be found, for example, on page 5, lines 6-7; page 12, line 2-page 13, line 16; and claim 3 of the originally-filed specification. No new matter has been added. Accordingly, claims 1, 2 and 4-20 remain in this application.

In the final Office Action, the Examiner rejected all of pending claims 1-20. Specifically, claims 1, 2, 4, 6-8 and 14 stand rejected under 35 U.S.C. § 103(a) as being obvious over the previously-cited Ward patent in view of the previously-cited '099 publication. Further, claims 9-12 and 15-17 stand rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent and the '099 publication, in view of the previously-cited Kanada publication. Further, claim 3 stands rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent in view of the '099 publication, and in further view of the previously-cited Yamaji patent. Claims 18-20 stand rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent, the '099 publication and the Kanada publication, and in further view of the Yamaji patent. Claim 13 stands rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent and the '099 publication, and in further view of the previously-cited Thomas patent. Finally, claim 5 stands rejected under 35 U.S.C. § 103(a) as being obvious over the Ward patent and the '099

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publication, and in further view of the previously-cited Inoue patent and Ogura patent. In view of the foregoing amendments and the following remarks, Applicants respectfully request reconsideration of these rejections.

Summary of the Invention

In one embodiment, and as set forth in independent claim 1 of the present application, as amended, provided is a loudspeaker diaphragm. This loudspeaker diaphragm includes a base layer having a woven fabric, and the woven fabric is polyethylene naphthalate fiber impregnated by a thermosetting resin. Still further, the polyethylene naphthalate fiber is an untwisted fiber.

In a further embodiment, and as set forth in independent claim 14 of the present application, as amended, provided is a loudspeaker including a loudspeaker diaphragm. The diaphragm includes a base layer, and the base layer is formed from a woven fabric of polyethylene naphthalate fiber impregnated with a thermosetting resin. The polyethylene naphthalate fiber is an untwisted fiber.

Independent claim 15 of the present application, as amended, is directed to a method for manufacturing a loudspeaker diaphragm. This method includes the steps of: impregnating a woven fabric of polyethylene naphthalate fiber with a thermosetting resin and curing the thermosetting resin, so as to form a base layer; adding an inactive gas at a supercritical state to a molten thermoplastic resin and extruding the mixture of the thermoplastic resin in the inactive gas at a prescribed temperature and pressure, so as to form a thermoplastic resin layer; and laminating the base layer and the thermoplastic resin layer. In addition, the polyethylene naphthalate fiber is an untwisted fiber.

In a still further embodiment, and as set forth in independent claim 17 of the present application, as amended, provided is a loudspeaker diaphragm. This loudspeaker diaphragm includes a base layer as the outermost layer, as well as a thermoplastic resin layer and a thermoplastic elastomer layer. The base layer includes a woven fabric of polyethylene naphthalate fiber impregnated with a thermosetting resin. The polyethylene naphthalate fiber is an untwisted fiber.

As now set forth in each of independent claims 1, 14, 15 and 17, it is expressly indicated that the polyethylene naphthalate fiber is an untwisted fiber. By using such an untwisted fiber, it is possible to greatly reduce thickness per weave density. As a result, a diaphragm having lightweight and excellent mechanical strength is obtained. Still further, if a woven fabric employing such a fiber is used, and since it is possible to greatly reduce an amount of an impregnating resin, i.e., greatly increase the fiber/resin ratio in the base layer, an internal loss is much improved. In addition, and since a fiber/resin ratio in the range of 60/40 to 80/20 can be realized, a loudspeaker diaphragm having a very small amount of resin can be obtained. As a result of using this untwisted fiber, and due to the "slip" of the respective polyethylene naphthalate fibers, an extraordinarily improved internal loss is realized compared to well-known film diaphragms. In fact, a loudspeaker diaphragm manufactured according to the claims of the present invention exhibits an internal loss of more than ten times as much as that of a polyethylene naphthalate film diaphragm. *See* page 24, line 11-page 25, line 6 of the originally-filed specification.

#### The Cited Prior Art

The Examiner has referred to the '099 publication, the Ward patent, the Kanada

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publication, the Watanabe publication, the Yamaji patent, EP '596, the Inoue patent and the Ogura patent throughout the prosecution of this application. In the present Office Action, the Examiner has withdrawn the '099 publication as a primary reference, and instead uses it as a secondary reference in combination with the Ward patent.

Applicants would again like to expressly indicate to the Examiner that the '099 publication is directed to a "film" diaphragm for use in connection with a micro speaker. Accordingly, the '099 publication teaches and suggests the use of a polyethylene naphthalate "film" for use in connection with small-diameter diaphragms and micro speakers. However, and as indicated in the Advisory Action, the Examiner still believes that the '099 publication and the Ward patent are properly combinable.

Notwithstanding the fact that Applicants again stress that the '099 publication is not properly combinable with the Ward patent, as they are used in different fields of endeavor, all of the independent claims have been further modified. In particular, the limitations of dependent claim 3 have now been included in the independent claims of the present application, and this limitation is directed to the embodiment where the polyethylene naphthalate fiber is an untwisted fiber.

In the Office Action, the Examiner indicates that such a limitation is not evident in either of the Ward patent or the '099 publication, and instead uses the Yamaji patent for such an alleged teaching. In particular, the Examiner indicates that the Yamaji patent teaches a base fiber that is untwisted with reference to column 2, lines 46-50 of this reference. This portion of the specification of the Yamaji patent is as follows:

In one embodiment, this invention provides a composite material made of a non-woven fibrous mat where inorganic monofilaments having a length of 10 to 200 mm and a diameter of 2 to 30 micrometers are partially bonded with a thermoplastic resin binder....

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Accordingly, the Yamaji patent specifically teaches the use of a non-woven fibrous material including inorganic monofilaments partially bonded with a thermoplastic resin binder.

The Cited Prior Art Does Not Teach or Suggest a Loudspeaker Diaphragm Having a Base Layer of Woven Fabric of PEN Fiber, Where the PEN Fiber is an Untwisted Fiber

As discussed above, the Examiner admits that neither the '099 publication nor the Ward patent teaches or suggests the use of polyethylene naphthalate fiber in the form of an untwisted fiber. Instead, the Examiner references the Yamaji patent, i.e., column 2, lines 46-50 of this reference, for such disclosure. However, as evidenced above, this portion of the specification of the Yamaji patent makes no mention whatsoever of a polyethylene naphthalate fiber in the form of an untwisted fiber. Instead, and as specifically disclosed in this reference, what is described is a non-woven fibrous mat formed from inorganic monofilaments. There is absolutely no mention whatsoever in this portion of the specification or anywhere in the Yamaji patent to use an untwisted fiber. Accordingly, neither the Yamaji patent nor any of the prior art of record, whether used alone or in combination, teaches or suggests a polyethylene naphthalate fiber impregnated with a thermosetting resin, wherein the polyethylene naphthalate fiber is an untwisted fiber, as specifically set forth in independent claims 1, 14, 15 and 17 of the present application.

Still further, it should be noted that the teachings of the Yamaji patent are specifically related to the use of non-woven fiber or fabric, whereas a woven fabric is specifically set forth in each of the independent claims of the present application. Accordingly, Applicants further submit that not only does the Yamaji patent not teach or suggest the use of an untwisted fiber, it is not even properly combinable (as a reference) with the '099 publication and the Ward

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patent, as it is specifically directed to non-woven fibrous materials. Therefore, it would not be obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of the '099 publication, the Ward patent and the Yamaji patent. It remains quite clear that the Examiner is using improper hindsight reconstruction and picking and choosing various pieces and parts of the prior art, and using the claims of the present application as a blueprint, in retroactively constructing the claimed invention. *However, and in any case, the cited prior art simply does not teach a loudspeaker diaphragm having a base layer of woven fabric of a polyethylene naphthalate fiber impregnated with a thermosetting resin, where the polyethylene naphthalate fiber is an untwisted fiber, as set forth in the independent claims.*

### Summary

The Examiner did not address many of the arguments presented in the Response After Final Rejection of April 9, 2007 in the Advisory Action. Accordingly, Applicants specifically incorporate herein by reference all of the arguments made on pages 5-9 of this Response. In that Response, Applicants asserted that other factors should be considered with respect to the presently-invented loudspeaker diaphragm, namely certain "secondary considerations" that further demonstrate that the claimed invention is not obvious to one skilled in the art. Further, Applicants provided specific experimental results that clearly evidence new and unexpected results in the form of an improved Young's modulus and internal loss, which result from practicing the present invention. These new and unexpected benefits are the results of considerable experimentation and analysis, and Applicants respectfully request that the Examiner take them into consideration.

For the foregoing reasons, independent claim 1, as amended, is not anticipated by

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or rendered obvious over any of the cited prior art, whether used alone or in combination.

Applicants respectfully submit Applicants respectfully submit that there is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 1 is respectfully requested. Claims 2-13 and 20 depend either directly or indirectly from and add further limitations to independent claim 1 and are believed to be allowable for the reasons discussed hereinabove in connection with independent claim 1.

For the above reasons, independent claim 14, as amended, is not anticipated by or rendered obvious over the prior art of record, whether used alone or in combination. There is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 14 is respectfully requested.

For the above reasons, independent claim 15, as amended, is not anticipated by or rendered obvious over the cited prior art, whether used alone or in combination. There is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious. Reconsideration of the rejection of independent claim 15 is respectfully requested. Claim 16 depends directly from and adds further limitations to independent claim 15 and is believed to be allowable for the reasons discussed hereinabove in connection with independent claim 15.

Finally, and for the foregoing reasons, independent claim 17, as amended, is not anticipated by or rendered obvious over the prior art of record, whether used alone or in combination. There is no hint or suggestion in any of the references cited by the Examiner to combine these references in a manner which would render the invention, as claimed, obvious.

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Reconsideration of the rejection of independent claim 17 is respectfully requested. Claims 18 and 19 depend either directly or indirectly from and add further limitations to independent claim 17 and are believed to be allowable for the reasons discussed hereinabove in connection with independent claim 17.

For all the foregoing reasons, Applicants believe that claims 1, 2 and 4-20 are patentable over the cited prior art and in condition for allowance. Reconsideration of the rejections and allowance of all pending claims 1, 2 and 4-20 are respectfully requested. Further, the undersigned respectfully urges the Examiner contact him in order to further discuss the present submission in order to move this case towards allowance. Applicants stand ready to interview this case prior to appeal based upon the Examiner's responsive position directed to this Amendment.

Respectfully submitted,

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